Dermoscopy/dermatoscopy and dermatopathology correlates of cutaneous neoplasms

Yélamos, Oriol ; Braun, Ralph P ; Liopyris, Konstantinos ; Wolner, Zachary J ; Kerl, Katrin ; Gerami, Pedram ; Marghoob, Ashfaq A

Abstract: Dermoscopy is increasingly used by clinicians (dermatologists, family physicians, podiatrists, doctors of osteopathic medicine, etc.) to inform clinical management decisions. Dermoscopic findings and/or images provided to pathologists offer an important insight into the clinician's diagnostic and management thought process. However, with limited dermoscopic training in dermatopathology, dermoscopic descriptions and images provided in the requisition form will provide little value to pathologists. Since most dermoscopic structures have direct histopathological correlates, dermoscopy can act as an excellent communication bridge between the clinician and the pathologist. In the first article of this continuing medical education series we review dermoscopic features and their histopathologic correlates.

DOI: https://doi.org/10.1016/j.jaad.2018.07.073

Accepted Manuscript

Dermoscopy/dermatoscopy and dermatopathology correlates of cutaneous neoplasms

Oriol Yélamos, MD, Ralph P. Braun, MD, Konstantinos Liopyris, MD, Zachary J. Wolner, BA, Katrin Kerl, MD, Pedram Gerami, MD, Ashfaq A. Marghoob, MD

PII: S0190-9622(18)32729-4

DOI: 10.1016/j.jaad.2018.07.073

Reference: YMJD 12859

To appear in: *Journal of the American Academy of Dermatology*

Received Date: 25 February 2018

Revised Date: 1 July 2018

Accepted Date: 4 July 2018

Please cite this article as: Yélamos O, Braun RP, Liopyris K, Wolner ZJ, Kerl K, Gerami P, Marghoob AA, Dermoscopy/dermatoscopy and dermatopathology correlates of cutaneous neoplasms, *Journal of the American Academy of Dermatology* (2018), doi: https://doi.org/10.1016/j.jaad.2018.07.073.

-Title: Dermoscopy/dermatoscopy and dermatopathology correlates of cutaneous neoplasms

-Authors: Oriol Yélamos, MD;[1,2] Ralph P Braun, MD[3] Konstantinos Liopyris, MD; [1] Zachary J Wolner, BA; [1] Katrin Kerl, MD; [3] Pedram Gerami, MD; [4] Ashfaq A Marghoob, MD; [1,5]

-**Institution**: [1]Dermatology Service, Memorial Sloan Kettering Cancer Center, New York, NY;
[2] Dermatology Department, Hospital Clínic, Universitat de Barcelona, Barcelona, Spain;
[3]Department of Dermatology, University Hospital Zürich, Switzerland;
[4]Department of Dermatology, Feinberg School of Medicine, The Robert H. Lurie Cancer Center, Northwestern University, Chicago, IL, USA
[5]Dermatology Service, Memorial Sloan Kettering Cancer Center, Hauppauge, NY

Corresponding author:

Oriol Yélamos, MD
oyelamos@gmail.com

Memorial Sloan Kettering Cancer Center
Dermatology Service
16 East 60th St. 4th Floor
New York, New York, 10022
646-888-6269

Dermatology Department
Hospital Clínic
Universitat de Barcelona
Villarroel 170, 08036 Barcelona, Spain

Funding: This research was partially funded by the NIH/NCI Cancer Center Support Grant P30 CA008748 and the Beca Excelencia Fundación Piel Sana (Dr Yélamos).

Conflicts of interest: PG has served as a consultant to Myriad Genomics, DermTech and Castle Biosciences and has received honoraria for this. AAM has served as a consultant to 3Gen and has received honoraria for this. The other authors do not have conflicts of interest relevant to the current manuscript.

Word, figure, and reference count: 3482 words, 11 figures, 6 tables, 79 references

Outline:

I. Introduction
   A. The separation of dermatology and dermatopathology
   B. Dermoscopy as a bridge between clinical dermatology and dermatopathology
   C. Dermoscopy terminology after the International Dermoscopy Society 2016 consensus

II. Dermoscopic structures and colors and their histopathological correlates
   A. Colors in dermoscopy
   B. Dermoscopic structures with high specificity for melanocytic neoplasms
      i. Pigment Network (lines, reticular)
      ii. Negative network (lines, reticular, hypopigmented, around brown clods)
      iii. Angulated lines (lines, angulated or polygonal)
      iv. Aggregated globules (clods, round or oval)
      v. Streaks (lines, radial – always at periphery)
      vi. Homogeneous blue pattern (structureless blue)
      vii. Parallel patterns (lines, parallel, in volar skin)
   C. Dermoscopic structures present in melanocytic neoplasms of special sites
      i. Volar skin
      ii. Face
      iii. Mucosal sites
      iv. Nail unit
   D. Dermoscopic structures with high specificity for non-melanocytic neoplasms
      i. Blue-gray ovoid nests, multiple blue-gray globules and dots (clods, dots, blue/gray)
      ii. Leaflike areas (lines, radial, connected to a common base)
      iii. Spoke wheel areas (Lines, radial, converging to a central dot or clod)
      iv. Strawberry pattern (structureless, red, interrupted by follicular openings)
      v. White circles
      vi. Dark dots/globules or round circles in linear arrangement (dots, clods, peripheral, arranged in lines)
      vii. Milia-like cysts (dots or clods, white, clustered or disseminated)
      viii. Comedo-like openings and crypts (Clods, brown, yellow, or orange, rarely black)
      ix. Central white patch (structureless zone, white, central)
   E. Non-specific dermoscopic structures
      i. Blotches (structureless zone, brown or black)
      ii. Dots (dots, black or brown)
      iii. Granularity/peppering (dots, gray) and scarlike depigmentation (structureless zone, white)
      iv. Shiny white structures (lines, dots, clods, white and shiny)
      v. Blue-whitish veil (structureless zone, blue)
      vi. Scale (structureless area yellow, brown, white)
      vii. Erosions and ulcerations (structureless area red, brown)
   F. Vessels

III. Conclusion

ABSTRACT

Dermoscopy is increasingly used by clinicians (dermatologists, family physicians, podiatrists, doctors of osteopathic medicine, etc.) to inform clinical management decisions. Dermoscopic findings and/or images provided to pathologists offer an important insight into the clinician's diagnostic and management thought process. However, with limited dermoscopic training in dermatopathology, dermoscopic descriptions and images provided in the requisition form will provide little value to pathologists. Since most dermoscopic structures have direct histopathological correlates, dermoscopy can act as an excellent communication bridge between the clinician and the pathologist. In the first article of this continuing medical education series we review dermoscopic features and their histopathologic correlates.

INTRODUCTION

Dermatology and histopathology have traditionally been linked. Skin biopsies are easy to perform, thus dermatologists couple their clinical skills with histopathology and use clinical information to tailor their histopathologic differential diagnosis. In the United States, the creation of dermatopathology in the 1970's uncoupled dermatology and histopathology. While this has led to more specialized physicians able to solve challenging cases with greater expertise, this separation can also lead to non-congruent diagnoses that ultimately require clinical-pathological correlation.

Dermoscopy or dermatoscopy is a non-invasive, handheld diagnostic instrument that is equipped with a magnification lens (between 10-20 X) and a polarized or non-polarized light source, allowing *en face* visualization of epidermal and dermal structures invisible to the naked eye. Dermoscopy is increasingly used by clinicians (dermatologists, family physicians, physician assistants)[2, 3] to inform clinical management decisions. While dermoscopic descriptions and/or images may be provided to pathologists as part of the requisition forms, this information is likely to be of limited value to the pathologist since most have received limited to no training in dermoscopy. Furthermore, many clinicians using dermoscopy remain unaware of the dermoscopy-histopathologic correlates. Acquiring this knowledge has the potential to not only improve the clinician's diagnostic accuracy but also provide prognostic information, help determine the type of biopsy to perform, and guide management of skin cancers. Since most dermoscopic structures have direct histopathologic correlates, dermoscopy offers the ideal bridge to improve clinical-pathological communication.

In the last decade, the description of dermoscopic structures by multiple independent researchers has led to redundant terminology. In an effort to standardize the nomenclature, in 2016 the International Dermoscopy Society (IDS) published a terminology consensus manuscript based on the most commonly used terms.[4, 5] In this current manuscript we use the consensus terminology and present both the descriptive and metaphoric terms agreed upon by the consensus members.

DERMOSCOPIC STRUCTURES AND COLORS AND THEIR HISTOPATHOLOGICAL CORRELATES

Key notes

- Colors seen in dermoscopy depend on the type of chromophores in the skin and their location.
- Melanin appears in multiple colors (black, brown, gray or blue) depending on its superficial or deep location.
- Dermoscopic structures with high specificity for melanocytic neoplasms include network, negative network, angulated lines, aggregated globules, streaks and parallel patterns on volar surfaces.
- When these structures are atypical (differences in size, shape, color or distribution) a diagnosis of melanoma is favored.

Colors in dermoscopy

Colors under the lens of dermoscopy depend on the type and location of the chromophores in the skin.[6-10] The most relevant colors when evaluating cutaneous neoplasms with dermoscopy include black, brown, blue, gray, yellow, orange, red and white. Most of these colors come from increases of normal components of the skin, such as melanin (brown, black, gray, blue), blood (red), sebum or keratin (yellow), or collagen (white). However, some colors associated with select dermoscopic structures are associated with specific pathologic features such as balloon-cell changes (white globules),[11] blood thrombosis (black lacunae), or cell xanthomization (homogeneous yellow to orange areas).[12] Melanin is the most common chromophore and the color will vary from black to brown to blue-gray depending on its concentration and location. Melanin in the stratum corneum or in the upper epidermis will have a black color, when present

in the epidermis and near the dermal-epidermal junction (DEJ) it will be brown, when present in the papillary dermis it will have a grayish hue, and when present in the deeper dermis it will appear blue.[7-9] Colors can provide valuable insight into the depth of a melanocytic lesion and thereby provide possible prognostic information. For example, when grossing a suspected melanoma, sectioning through a blue area (pigment in the deep dermis) will likely reveal the thickest section of the tumor.

Colors are subject to varying perception secondary to inherent variation from person to person.[13] Therefore, while evaluation of color in dermoscopy is important when evaluating a lesion, it can, at times, distract attention from diagnostic dermoscopic structures. Evaluating gray scale (black and white) dermoscopic images can remove potential distracting or biasing colors and make dermoscopic structures more conspicuous (figure 1).[14]

Dermoscopic structures with high specificity for melanocytic neoplasms

Dermoscopy can help differentiate melanocytic from non-melanocytic lesions through structures that are highly specific for melanocytic neoplasms.[15, 16] The description of these features and their histopathologic correlates are described below and summarized in Table I. While these structures are usually associated with melanocytic neoplasms, they can on occasion be encountered in non-melanocytic lesions (Table II).[17]

Pigment Network (lines, reticular)

Pigment network corresponds to brown lines forming a reticular pattern in a grid-like arrangement.[4] Histologically, the lines correspond to increased pigmentation along elongated rete ridges due to an increased density of melanocytes and pigmented keratinocytes per unit area.[18]

Conversely, the lighter "holes" among the pigmented lines correspond to the suprapapillary plates (figure 2).[18] Regular pigment network is common in melanocytic nevi, but can be seen in non-melanocytic lesions such as dermatofibromas or accessory nipples (table II).[19, 20] Atypical pigment network lines varying in size, color, thickness or distribution are more commonly found in dysplastic nevi and superficial spreading melanoma.[4] Histologically, atypical pigment network reveals disarrangement of the rete ridges with pleomorphic melanocytes and changes in melanin distribution within the epithelium.[21]

Negative Network (lines, reticular, hypopigmented, around brown clods)

Negative network consists of serpiginous hypopigmented lines that surround hyperpigmented, elongated-to-curvilinear globular structures.[22] One study suggested that the negative network corresponds to hypopigmented elongated rete ridges bridging and surrounding large nests of melanocytes within the dermal papillae.[6] However, another study could not corroborate these findings.[22] Negative network occurs in Spitz nevi and in melanomas,[23] specifically melanomas arising in nevi (figure 1).[24, 25]

Angulated lines (lines, angulated or polygonal)

Angulated lines are linear lines forming a zigzag pattern. These lines can coalesce into polygons with the most common being a rhomboid. When present in the face these structures are called rhomboidal structures[4] and are highly suggestive of lentigo maligna (LM).[26, 27] Outside the face they are called polygons and are suggestive of lentiginous melanomas of chronically sun-exposed skin.[28] Histologically, angulated lines correspond to a flattened DEJ with fewer and more attenuated rete ridges, proliferation of confluent atypical junctional melanocytes, and dermal melanophages.[29] However, it remains elusive as to why these structures occur in a linear,

zigzag and polygonal fashion. We speculate that this may somehow be related to skin markings but have no direct evidence for this yet.

Globules (clods, small, round or oval)

Globules are round to oval, usually brown to black structures, that are found clustered together in aggregates of three or more or are found located along the periphery of a melanocytic lesion (Figure 3).[4 9, 10] Brown and black globules correspond to melanocytic nests at the DEJ or in the papillary dermis, whereas blue globules represent deeper nests located in the reticular dermis.[7] Globules distributed along the perimeter of a melanocytic neoplasm correspond with the lesion's radial growth phase.[4, 7] Irregular globules with increased variability in their sizes, shapes and/or colors and should raise suspicion for melanoma.[4] Occasionally, one can see white globules, which correspond to melanocyte nests displaying balloon cell changes.[11]

Streaks (lines, radial – always at periphery)

Streaks, which encompasses radial streaming and pseudopods, are radial projections located at the periphery of the lesion. These projections emanate from the tumor and project towards normal skin. In radial streaming the projections are linear, whereas in pseudopods the projections have small terminal knobs. While there may be differences in the rate of growth of tumors with radial streaming versus pseudopods, both structures correspond on histopathology to confluent junctional nests of pigmented melanocytes at the periphery (figure 4).[18] When streaks are located symmetrically around the entire lesion they favor a Reed nevus. Conversely, if the streaks are located asymmetrically they favor a superficial spreading melanoma.[30]

Homogenous blue pattern (structureless blue)

Homogenous blue pattern is a structureless pattern characterized only by the presence of blue throughout the lesion.[4] This pattern reveals a dermal population of densely pigmented melanocytes and can be seen in blue nevi, combined nevi, pigmented nodular melanoma and primary or metastatic melanoma.[7] Therefore, when evaluating a homogenous blue lesion, the clinical history is paramount; a stable, long-standing lesion favors a blue nevus, whereas a new lesion in a patient with a history of melanoma should raise concern for metastatic melanoma.

Dermoscopic structures present in melanocytic neoplasms located in special sites

In volar, facial, mucosal, and nail lesions, unique microanatomy produces different dermoscopic patterns. Descriptions of the dermoscopic features and their histopathologic correlates are described below and summarized in Table III.

Volar skin

In palmoplantar skin, melanin tends to be located mainly in the furrows or the ridges of the dermatoglyphics, resulting in two predominant patterns: the parallel furrow pattern and the parallel ridge pattern. The former consists of pigment that is located in the furrows and is frequently associated with benign melanocytic lesions (figure 5, Table III). Histologically, it results from nevomelanocytes preferably transferring pigment to keratinocytes located in the crista limitans (furrows).[31] The parallel ridge pattern consists of pigment located on the ridges and is associated mostly with melanoma (figure 5, Table III). It has been shown that malignant melanocytes tend to be more abundant around the rete ridges associated with the acrosyringia (crista intermedia).[31] Some have hypothesized that melanoma arises from stem cells residing

around the acrosyringium and have further speculated that the microenvironment associated with the crista intermedia may be more conducive to the proliferation of these malignant cells.[32]

Facial skin

The microanatomy of facial skin usually reveals a flattened DEJ interrupted by numerous adnexal openings. Because of the flattened DEJ, the reticular pattern is not common on the face. Instead, pigmented lesions on the face often have a more homogeneous appearance that is interrupted by adnexal openings, leading a pseudonetwork pattern. In other words, the pseudonetwork pattern corresponds to a brown structureless area that is interrupted by follicular openings, which in combination leads to a pattern reminiscent of a network.[4] Histologically, it corresponds to pigmented cells located in the epidermis and DEJ interrupted by follicular openings.[6, 26] Several dermoscopic features which disrupt the pseudonetwork have been associated with LM. The most relevant are blotches with obliteration of the follicles, concentric circles (or circles within circles), gray circles, asymmetric follicular openings (incomplete circles) and rhomboidal structures (figure 6, table III).[26, 33, 34] These structures represent a proliferation of atypical melanocytes along the DEJ with varying degrees of follicular and dermal invasion.[6, 26, 35] Gray circles can also be seen in pigmented actinic keratosis, and generally present as gray to beige homogeneous areas surrounding the hair follicle but sparing the follicular opening.

Mucosal sites

The mucosal sites include the glabrous portion of the lips, mucosal aspect of the lips, and the glabrous portion of the male and female genitalia. Few studies are available to correlate the histology of dermoscopic structures seen on mucosal sites. Naked eye clinical examination of

mucosal lesions can be challenging since both benign melanocytic lesions and early melanoma often manifest an atypical morphology.[36, 37]

Four dermoscopic structures can be seen in benign mucosal melanocytic lesions: dots/globules, structureless areas, circles including half circles (fish scale pattern), and lines. These structures are not discussed in the 2016 IDS consensus paper since mucosal sites were not evaluated in the consensus. The dotted-globular pattern presents with multiple dots/globules of similar sizes and shapes and corresponds to aggregates of melanin in the upper lamina propria.[38] A homogenous pattern consists of structureless areas on dermoscopy, and corresponds to flattened rete ridges along with acanthosis.[38] A ring-like pattern consists of brown pigmented circles, while a fish scale-like pattern contains brown half circles. Circles/half circles in the mucosae correspond to hyperpigmented epithelial cells located along broadened rete ridges, which skip the papillae.[38, 39] A hyphal pattern consists of lines resembling fungal hyphae. Histologically, lines correspond to hyperpigmentation of the tip of the rete ridges, which are oriented obliquely.[38] Lines can also adopt a parallel-like or reticular-like appearance.[39, 40]

Dermoscopically, mucosal melanomas usually reveal multiple colors and dermoscopic structures that are distributed in a disorganized manner.[41] Mucosal melanomas can also contain dermoscopic features normally associated with cutaneous melanomas of non-special sites such as regression structures or blue-whitish veil.[42] To date, the best diagnostic model to differentiate benign melanocytic lesions from melanoma found that lesions with structureless areas in addition to blue, gray or white color was associated with 100% sensitivity and 82% specificity for mucosal melanoma.[41] However, these findings are limited by the fact that most mucosal

melanomas in the study were advanced lesions. Several case reports have shown that early mucosal melanomas may not show these features.[43, 44]

Nail unit

The differential diagnosis for melanonychia striata or longitudinal melanonychia includes traumatism, infection, melanocytic activation (drug-induced pigmentation, lentigo, post-inflammatory pigment) or melanocytic proliferation (nevus, melanocytic hyperplasia or melanoma).[6, 45] Dermoscopy helps distinguish between these entities and can guide the most appropriate area within the nail matrix to perform a biopsy (proximal versus distal). The IDS consensus statement on dermoscopic terminology did not include features specific to the nail unit.

Pigment granules within the pigmented nail band can help distinguish whether the melanonychia is due to melanocyte activation or proliferation. The absence of granules within a grayish colored band is highly suggestive of melanocytic activation (epithelial hyperpigmentation). In contrast, the bands due to melanocytic proliferation are usually brown to black in color, have brown/black granules (melanin inclusions) and usually also have multiple prominent linear lines within the band.[46] When evaluating melanonychia due to melanocytic proliferation the main objective is to differentiate nail matrix nevi from melanoma. Melanonychia revealing multiple colors, individual lines within the band displaying irregular spacing, or lines that fail to remain parallel (loss of parallelism) should raise concern for melanoma.[46] When evaluating the pigmented nail band it is also important to examine the cuticle, hyponychium and nail plate. The presence of pigment in the proximal nail fold

(Hutchinson sign and micro-Hutchison sign), pigmentation on the hyponychium, and nail dystrophy are associated with melanoma.[46]

Dermoscopy of the free edge of the nail plate can guide where to biopsy in the nail matrix. Melanocytic lesions located in the proximal nail matrix will reveal increased pigment on the upper part of the free edge of the nail plate on dermoscopy. Conversely, pigment located in the lower part of the nail's free edge corresponds to a melanocytic lesion located in the distal nail matrix (figure 7).[47]

Dermoscopic structures with high specificity for non-melanocytic neoplasms

Several dermoscopic features are relatively specific to non-melanocytic neoplasms such as basal cell carcinoma (BCC), seborrheic keratosis (SK), and dermatofibroma (Table IV). The presence of one of these structures or a combination of these structures cannot only help in rendering a more accurate diagnosis but can also help in differentiating aggressive tumors from less aggressive tumors and help predict tumor subtypes (CME part 2).

Blue-gray ovoid nests, multiple blue-gray globules and dots (clods, dots, blue/gray)

Blue-gray globules usually appear as multiple non-aggregated oval structures. Blue-gray dots usually appear as dots distributed in a random buck-shot scattered pattern. Blue-gray globules correspond to small BCC tumor nests in the dermis and blue-gray dots represent small BCC aggregates at the DEJ or in superficial dermis. Ovoid nests are well-circumscribed larger blue-gray globules and correspond histologically to large BCC tumor islands in the dermis (figure 8A-B).[4, 6, 48] The blue-gray color of these BCC tumor islands is due to melanocyte colonization and melanization of the BCC tumor islands.[49]

Leaflike areas (lines, radial, connected to a common base), and spoke wheel areas (lines, radial, converging to a central dot or clod)

Leaflike areas are brown to blue-gray projections connected radially at a common base resulting in structures that resemble the shape of leaves (figure 8C-D).[4] A variant of the leaflike structure is the spoke wheel area, which consists of radial projections that are connected at a common central darker base. At times the radial projections are poorly defined resulting in globular structures displaying a central dark hub (concentric structures). Histologically, all these structures correspond to pigmented BCC nests at the DEJ and in the superficial papillary dermis.[6, 48] In the absence of pigment network, the presence of any of these structures is diagnostic for BCC.[50]

Strawberry pattern (structureless, red, interrupted by follicular openings)

The strawberry pattern consists of an erythematous pseudonetwork interrupted by keratin-filled follicular openings (Table IV).[4, 51] This pattern is characteristic of non-pigmented actinic keratosis (AK).[51] Histologically this reveals partial thickness keratinocyte atypia, keratin in follicular ostia and increase in vasculature.

White circles

White circles are bright white circles surrounding an orange/yellow keratin plug (Table IV).[52] Histologically, they correspond to acanthosis and hypergranulosis of the infundibular epidermis. White circles are associated with well-differentiated squamous cell carcinoma (SCC) and keratoacanthomas.[52]

Dark dots/globules or round circles in linear arrangement (dots, clods, peripheral, arranged in lines)

Pigmented SCC in situ often reveals brown to gray oval to round circular structures. These structures are often distributed linearly. Histologically, they represent clusters of atypical basal pigmented keratinocytes.[53]

Milia-like cysts (dots or clods, white, clustered or disseminated)

Milia-like cysts are white to yellow round structures that shine brightly[4] under non-polarized dermoscopy. Toggling between the polarized and non-polarized light causes these structures to "blink".[55] Histologically, they correspond to intraepidermal keratin cysts (figure 9).[4, 6, 54] Multiple milia-like cysts are typical of SKs but can also be seen in melanocytic nevi, melanomas, and BCCs.[54]

Comedo-like openings and crypts (clods, brown, yellow, or orange, rarely black)

Comedo-like openings are round to oval, brown to black epidermal invagination. When the invagination is larger and more elongated then it is called a crypt.[4] Histologically, they correspond to epidermal invaginations filled with keratin (figure 9).[6, 54] They are typically seen in SKs but can also be present in papillomatous lesions such as intradermal nevi.

Central white patch (structureless zone, white, central)

Central white patch is a white structureless area located in the center of a lesion (Table IV).[4] A central white patch in combination with a peripheral network is characteristic of

dermatofibromas. Histopathologically, this feature corresponds to fibrosis in the papillary dermis.[19]

Non-specific dermoscopic structures

Several dermoscopic features are seen in melanocytic lesions and non-melanocytic lesions. The description of these features and their histopathologic correlates is described below and summarized in Table V.

Dots (dots, any color)

Dots are round structures similar to, but smaller than, globules. Their size is about the size of the diameter of a terminal hair follicle.[4] Brown, black, gray and blue dots are most common in cutaneous neoplasms.[6, 9] Black dots correlate with pigment in the upper epidermis or in the stratum corneum, and occur frequently in small heavily pigmented compound or junctional nevi (figure 10A-B). Brown dots correlate with small melanocytic nests in the epidermis or in the DEJ. Blue-gray dots correspond to free pigment in the papillary dermis or inside dermal melanophages (the equivalent to peppering - see below) (figure 10C-D). Blue-gray dots correspond to small BCC tumor nests. Red dots are equivalent to dotted vessels and can be present in multiples entities such as Spitz nevi, keratinocyte carcinomas, and melanomas.[16, 18, 56]

Blotches (structureless zone, brown or black)

Blotches are dark brown to black structureless areas that obscure the ability to see any underlying structures.[4, 9] A regular, centrally-located blotch can be found in melanocytic nevi. However, blotches that appear in multiples or are off-centered are considered irregular and increase the suspicion for melanoma.[4, 57] Histologically, they represent hyperpigmentation with

abundant melanin throughout the epidermis, with or without presence of pigment in the underlying dermis.[56] Sometimes, blotches are due to heavy concentration of melanin in the stratum corneum, as can occur after an intense burst of ultraviolet exposure. When melanin is confined to the stratum corneum it is called a lamella,[58] which can be stripped off with a piece of tape, thereby allowing the observer to see the underlying dermoscopic structures.[59] Blotches can also be seen in SKs and BCCs.

Granularity/peppering (dots, gray) and scarlike depigmentation (structureless zone, white)

These two structures correspond with histologic regression. They can occur together or independent of each other.[4] Peppering or granularity appears as fine blue-gray dots on dermoscopy. They correspond to free melanin in the dermis or inside melanophages. Peppering can be seen in melanomas, in lichen planus-like keratoses (LPLK),[4] and focally in melanocytic nevi.[60] Scarlike areas are porcelain-white structureless areas lacking shiny white structures or vessels and are lighter in color than perilesional skin.[4] Histologically, these areas contain dermal fibroplasia (figure 10C-D)[18] and, therefore, are not optimal areas for step sectioning when grossing a suspected melanoma since they may reveal fibrosis and may lead to tumor thickness underestimation.

Shiny white structures (lines, dots, clods, white and shiny)

Shiny white structures are only seen with polarized dermoscopy and encompass shiny white streaks, blotches, strands and rosettes.

-*Shiny white streaks* are short white lines that are often oriented orthogonally to each other.[4, 61] Histopathologically they correspond to altered dermal collagen resulting from stromal alterations (figure 11).[22, 62] They are only visible with polarized dermoscopy and may require the operator to rotate the dermatoscope over the lesion as the birefringent properties depend on the angle of the collagen (angular dependence). Shiny white streaks are associated with Spitz nevi, atypical nevi, melanomas, LPLKs and BCCs.[61-64]

-*Rosettes* present as four round bright white dots arranged in a four-leaved clover pattern. Rosettes occur in sun-damaged skin and have been described in AKs, SCCs, and rarely in melanomas.[65-68] Histologically, they correspond with hyperkeratosis of the follicular openings.[67, 68]

-*Shiny white blotches and strands* are small to large white homogenous to linear areas. The white blotches can vary in size and shape. The strands tend to be long linear white areas. These linear strands are often arranged parallel to each other and they rarely intersect.[69] These structures are common in BCCs and are rarely found in melanomas and LPLKs.[67, 69] Although shiny white blotches and strands are thought to correspond to fibrosis of underlying stroma, the exact histopathological correlate remains to be elucidated.

Blue-whitish veil (structureless zone, blue)

Blue-whitish veil occurs in raised/palpable areas of a lesion and appears as an irregular bluish blotch with overlying white ground-glass haze, occupying only part of the lesion.[9, 30] A blue-whitish veil should raise concern for melanoma, but can also be seen in Reed nevi, Spitz nevi and in non-melanocytic lesions such as pyogenic granuloma, BCC, and SK.[30, 70, 71] In

melanocytic neoplasms, it represents heavily pigmented melanocytes and/or melanophages in the dermis with acanthosis and compact orthokeratosis (figure 11).[9, 18, 72]

Scale

Common terms such as scale or erosions were not included in the 2016 dermoscopy terminology consensus since they are also clinically identifiable without dermoscopy. Scale is common in AKs, SCC, porokeratosis, and inflammatory skin diseases. They correspond to homogenous opaque yellow to brown structures and histologically correspond to hyperkeratosis and parakeratosis.[73, 74]

Erosions and ulcerations

Erosions are small brown-red to orange-yellow crusts which histologically reveal epidermal loss.[48] Multiple small erosions are suggestive of superficial BCC, but can also occur in SCC and after trauma.[75] Ulcerations are larger red-to-orange structureless areas with loss of the entire epidermis to the depth of the papillary dermis. A single ulceration is characteristic of nodular BCC but can also be seen in melanoma, SCC and after trauma.[48]

Vessels

While certain vessel morphologies are associated with specific disease entities (Table VI), there are no observable direct histopathology correlates for these vessels visible on routine step sections and therefore are not detailed in this review. The morphology of the vessel seen with dermoscopy depends on the thickness of the lesion. For example, in flat lesions the vessels are seen as red dots on dermoscopy, whereas in raised lesions the vessels can adopt a looped morphology resulting in comma or hairpin vessels.[6, 76]

CONCLUSION

The first part of this CME highlights the dermoscopic features for which histopathologic correlates exist. Understanding and appreciating these correlates can improve the clinician's diagnostic accuracy and can guide the clinician in selecting the most appropriate area to biopsy. In addition, appreciating these correlates can also help inform the pathologist and aid the dermatopathologists in deciding the most appropriate areas within the lesion to section.

REFERENCES

1. Bernhardt MS. The History of Dermatopathology. JAMA Dermatol 2013;149(10):1140.

2. Argenziano G, Puig S, Zalaudek I et al. Dermoscopy improves accuracy of primary care physicians to triage lesions suggestive of skin cancer. J Clin Oncol 2006;24(12):1877-1882.

3. Rosendahl C, Cameron A, McColl I et al. Dermatoscopy in routine practice - 'chaos and clues'. Aust Fam Physician 2012;41(7):482-487.

4. Kittler H, Marghoob AA, Argenziano G et al. Standardization of terminology in dermoscopy/dermatoscopy: Results of the third consensus conference of the International Society of Dermoscopy. J Am Acad Dermatol 2016;74(6):1093-1106.

5. Kittler H , Braun R. Terminology. Available in: https://dermoscopediaorg/Terminology Last Accessed 25.2.2018

6. Marghoob AA, Braun RP , Malvehy J. Atlas of Dermoscopy Second Edition Second Edition New York Informa Healthcare; 2012.

7. Woltsche N, Schmid-Zalaudek K, Deinlein T et al. Abundance of the benign melanocytic universe: Dermoscopic-histopathological correlation in nevi. J Dermatol 2017;44(5):499-506.

8. Zalaudek I, Docimo G , Argenziano G. Using dermoscopic criteria and patient-related factors for the management of pigmented melanocytic nevi. Arch Dermatol 2009;145(7):816-826.

9. Malvehy J. Handbook of dermoscopy. London: Informa Healthcare; 2006.

10. Braun R , Kerl K. Histopathologic correlation of dermoscopic structures. Available in: https://dermoscopedia.org/Histopathologic_correlation_of_dermoscopic_structures .Last Accessed 25.2.2018

505 11. Jaimes N, Braun RP, Stolz W et al. White globules correlate with balloon cell nevi nests. J
506 Am Acad Dermatol 2011;65(4):e119-120.
507 12. Banuls J, Arribas P, Berbegal L et al. Yellow and orange in cutaneous lesions: clinical and
508 dermoscopic data. J Eur Acad Dermatol Venereol 2015;29(12):2317-2325.
509 13. Neitz J , Jacobs GH. Polymorphism in normal human color vision and its mechanism.
510 Vision Res 1990;30(4):621-636.
511 14. Bajaj S, Marchetti MA, Navarrete-Dechent C et al. The Role of Color and Morphologic
512 Characteristics in Dermoscopic Diagnosis. JAMA Dermatol 2016;152(6):676-682.
513 15. Chen LL, Dusza SW, Jaimes N et al. Performance of the First Step of the 2-Step
514 Dermoscopy Algorithm. JAMA Dermatol 2015;151(7):715-721.
515 16. Argenziano G, Soyer HP, Chimenti S et al. Dermoscopy of pigmented skin lesions: results
516 of a consensus meeting via the Internet. J Am Acad Dermatol 2003;48(5):679-693.
517 17. Rishpon A , Marghoob A. Exceptions to the algorithm. Available in:
518 https://dermoscopediaorg/Exceptions_to_the_algorithm Last Accessed 25.2.2018
519 18. Massi D, De Giorgi V , Soyer HP. Histopathologic correlates of dermoscopic criteria.
520 Dermatol Clin 2001;19(2):259-268.
521 19. Zaballos P, Puig S, Llambrich A et al. Dermoscopy of dermatofibromas: a prospective
522 morphological study of 412 cases. Arch Dermatol 2008;144(1):75-83.
523 20. Scope A, Benvenuto-Andrade C, Agero AL et al. Nonmelanocytic lesions defying the two-
524 step dermoscopy algorithm. Dermatol Surg 2006;32(11):1398-1406.
525 21. Russo T, Piccolo V, Ferrara G et al. Dermoscopy pathology correlation in melanoma. J
526 Dermatol 2017;44(5):507-514.

22. Pizzichetta MA, Canzonieri V, Soyer PH et al. Negative pigment network and shiny white streaks: a dermoscopic-pathological correlation study. Am J Dermatopathol 2014;36(5):433-438.

23. Pizzichetta MA, Talamini R, Marghoob AA et al. Negative pigment network: an additional dermoscopic feature for the diagnosis of melanoma. J Am Acad Dermatol 2013;68(4):552-559.

24. Bassoli S, Ferrari C, Borsari S et al. Negative pigment network identifies a peculiar melanoma subtype and represents a clue to melanoma diagnosis: a dermoscopic study of 401 melanomas. Acta Derm Venereol 2013;93(6):650-655.

25. Shitara D, Nascimento M, Ishioka P et al. Dermoscopy of Naevus-associated Melanomas. Acta Derm Venereol 2015;95(6):671-675.

26. Schiffner R, Schiffner-Rohe J, Vogt T et al. Improvement of early recognition of lentigo maligna using dermatoscopy. J Am Acad Dermatol 2000;42(1 Pt 1):25-32.

27. Slutsky JB , Marghoob AA. The zig-zag pattern of lentigo maligna. Arch Dermatol 2010;146(12):1444.

28. Jaimes N, Marghoob AA, Rabinovitz H et al. Clinical and dermoscopic characteristics of melanomas on nonfacial chronically sun-damaged skin. J Am Acad Dermatol 2015;72(6):1027-1035.

29. Vanden Daelen A, Ferreira I, Marot L et al. A Digital Dermoscopy Follow-up Illustration and a Histopathologic Correlation for Angulated Lines in Extrafacial Lentigo Maligna. JAMA Dermatol 2016;152(2):200-203.

30. Braun RP, Rabinovitz HS, Oliviero M et al. Dermoscopy of pigmented skin lesions. J Am Acad Dermatol 2005;52(1):109-121.

31. Ishihara Y, Saida T, Miyazaki A et al. Early acral melanoma in situ: correlation between the parallel ridge pattern on dermoscopy and microscopic features. Am J Dermatopathol 2006;28(1):21-27.

32. Okamoto N, Aoto T, Uhara H et al. A melanocyte--melanoma precursor niche in sweat glands of volar skin. Pigment Cell Melanoma Res 2014;27(6):1039-1050.

33. Lallas A, Tschandl P, Kyrgidis A et al. Dermoscopic clues to differentiate facial lentigo maligna from pigmented actinic keratosis. Br J Dermatol 2016;174(5):1079-1085.

34. Tschandl P, Rosendahl C , Kittler H. Dermatoscopy of flat pigmented facial lesions. J Eur Acad Dermatol Venereol 2015;29(1):120-127.

35. Gomez-Martin I, Moreno S, Andrades-Lopez E et al. Histopathologic and Immunohistochemical Correlates of Confocal Descriptors in Pigmented Facial Macules on Photodamaged Skin. JAMA Dermatol 2017;153(8):771-780.

36. Yelamos O, Merkel EA, Sholl LM et al. Nonoverlapping Clinical and Mutational Patterns in Melanomas from the Female Genital Tract and Atypical Genital Nevi. J Invest Dermatol 2016;136(9):1858-1865.

37. NIH Consensus conference. Diagnosis and treatment of early melanoma. JAMA 1992;268(10):1314-1319.

38. Lin J, Koga H, Takata M et al. Dermoscopy of pigmented lesions on mucocutaneous junction and mucous membrane. Br J Dermatol 2009;161(6):1255-1261.

39. Ferrari A, Agozzino M, Ardigo M et al. Dermoscopic and confocal microscopy patterns of vulvar mucosal melanotic macules. J Am Acad Dermatol 2014;70(4):e81-82.

40. Ferrari A, Buccini P, Covello R et al. The ringlike pattern in vulvar melanosis: a new dermoscopic clue for diagnosis. Arch Dermatol 2008;144(8):1030-1034.

41. Blum A, Simionescu O, Argenziano G et al. Dermoscopy of pigmented lesions of the mucosa and the mucocutaneous junction: results of a multicenter study by the International Dermoscopy Society (IDS). Arch Dermatol 2011;147(10):1181-1187.

42. Matsushita S, Kageshita T , Ishihara T. Comparison of dermoscopic and histopathological findings in a mucous melanoma of the lip. Br J Dermatol 2005;152(6):1324-1326.

43. Rogers T, Pulitzer M, Marino ML et al. Early diagnosis of genital mucosal melanoma: how good are our dermoscopic criteria? Dermatol Pract Concept 2016;6(4):43-46.

44. Betti R, Menni S , Crosti C. Melanoma of the glans penis. Eur J Dermatol 2005;15(2):113-115.

45. Cooper C, Arva NC, Lee C et al. A clinical, histopathologic, and outcome study of melanonychia striata in childhood. J Am Acad Dermatol 2015;72(5):773-779.

46. Braun RP, Baran R, Le Gal FA et al. Diagnosis and management of nail pigmentations. J Am Acad Dermatol 2007;56(5):835-847.

47. Braun RP, Baran R, Saurat JH et al. Surgical Pearl: Dermoscopy of the free edge of the nail to determine the level of nail plate pigmentation and the location of its probable origin in the proximal or distal nail matrix. J Am Acad Dermatol 2006;55(3):512-513.

48. Lallas A, Apalla Z, Ioannides D et al. Dermoscopy in the diagnosis and management of basal cell carcinoma. Future Oncol 2015;11(22):2975-2984.

49. Segura S, Puig S, Carrera C et al. Dendritic cells in pigmented basal cell carcinoma: a relevant finding by reflectance-mode confocal microscopy. Arch Dermatol 2007;143(7):883-886.

50. Menzies SW, Westerhoff K, Rabinovitz H et al. Surface microscopy of pigmented basal cell carcinoma. Arch Dermatol 2000;136(8):1012-1016.

51. Zalaudek I, Giacomel J, Argenziano G et al. Dermoscopy of facial nonpigmented actinic keratosis. Br J Dermatol 2006;155(5):951-956.

52. Rosendahl C, Cameron A, Argenziano G et al. Dermoscopy of squamous cell carcinoma and keratoacanthoma. Arch Dermatol 2012;148(12):1386-1392.

53. Cameron A, Rosendahl C, Tschandl P et al. Dermatoscopy of pigmented Bowen's disease. J Am Acad Dermatol 2010;62(4):597-604.

54. Minagawa A. Dermoscopy-pathology relationship in seborrheic keratosis. J Dermatol 2017;44(5):518-524.

55. Braun RP, Scope A , Marghoob AA. The "blink sign" in dermoscopy. Arch Dermatol 2011;147(4):520.

56. Yadav S, Vossaert KA, Kopf AW et al. Histopathologic correlates of structures seen on dermoscopy (epiluminescence microscopy). Am J Dermatopathol 1993;15(4):297-305.

57. Stoecker WV, Gupta K, Stanley RJ et al. Detection of asymmetric blotches (asymmetric structureless areas) in dermoscopy images of malignant melanoma using relative color. Skin Res Technol 2005;11(3):179-184.

58. Kilinc Karaarslan I, Teban L, Dawid M et al. Changes in the dermoscopic appearance of melanocytic naevi after photochemotherapy or narrow-band ultraviolet B phototherapy. J Eur Acad Dermatol Venereol 2007;21(4):526-531.

59. Guillod JF, Skaria AM, Salomon D et al. Epiluminescence videomicroscopy: black dots and brown globules revisited by stripping the stratum corneum. J Am Acad Dermatol 1997;36(3 Pt 1):371-377.

60. Zalaudek I, Argenziano G, Ferrara G et al. Clinically equivocal melanocytic skin lesions with features of regression: a dermoscopic-pathological study. Br J Dermatol 2004;150(1):64-71.

621 61. Botella-Estrada R, Requena C, Traves V et al. Chrysalis and negative pigment network in
622 Spitz nevi. Am J Dermatopathol 2012;34(2):188-191.
623 62. Balagula Y, Braun RP, Rabinovitz HS et al. The significance of crystalline/chrysalis
624 structures in the diagnosis of melanocytic and nonmelanocytic lesions. J Am Acad Dermatol
625 2012;67(2):194.e191-198.
626 63. Shitara D, Ishioka P, Alonso-Pinedo Y et al. Shiny white streaks: a sign of malignancy at
627 dermoscopy of pigmented skin lesions. Acta Derm Venereol 2014;94(2):132-137.
628 64. Verzi AE, V.L. Q, Walton K et al. The diagnostic value and histologic correlate of distinct
629 patterns of shiny white streaks for the diagnosis of melanoma: a retrospective, case-control
630 study. J Am Acad Dermatol 2018;78(5):913-919.
631 65. Cuellar F, Vilalta A, Puig S et al. New dermoscopic pattern in actinic keratosis and
632 related conditions. Arch Dermatol 2009;145(6):732.
633 66. Liebman TN, Scope A, Rabinovitz H et al. Rosettes may be observed in a range of
634 conditions. Arch Dermatol 2011;147(12):1468.
635 67. Liebman TN, Rabinovitz HS, Dusza SW et al. White shiny structures: dermoscopic
636 features revealed under polarized light. J Eur Acad Dermatol Venereol 2012;26(12):1493-
637 1497.
638 68. Gonzalez-Alvarez T, Armengot-Carbo M, Barreiro A et al. Dermoscopic rosettes as a clue
639 for pigmented incipient melanoma. Dermatology 2014;228(1):31-33.
640 69. Navarrete-Dechent C, Bajaj S, Marchetti MA et al. Association of Shiny White Blotches
641 and Strands With Nonpigmented Basal Cell Carcinoma: Evaluation of an Additional
642 Dermoscopic Diagnostic Criterion. JAMA Dermatol 2016;152(5):546-552.
643 70. Zaballos P, Rodero J, Serrano P et al. Pyogenic granuloma clinically and dermoscopically
644 mimicking pigmented melanoma. Dermatol Online J 2009;15(10):10.

71. Suppa M, Micantonio T, Di Stefani A et al. Dermoscopic variability of basal cell carcinoma according to clinical type and anatomic location. J Eur Acad Dermatol Venereol 2015;29(9):1732-1741.

72. Massi D, De Giorgi V, Carli P et al. Diagnostic significance of the blue hue in dermoscopy of melanocytic lesions: a dermoscopic-pathologic study. Am J Dermatopathol 2001;23(5):463-469.

73. Wolner Z, Yélamos O, Liopyris K et al. Enhancing Skin Cancer Diagnosis with Dermoscopy. Dermatol Clin 2017;35(4):417-437.

74. Tan JM, Lambie D, Sinnya S et al. Histopathology and reflectance confocal microscopy features of photodamaged skin and actinic keratosis. J Eur Acad Dermatol Venereol 2016;30(11):1901-1911.

75. Ahnlide I, Zalaudek I, Nilsson F et al. Preoperative prediction of histopathological outcome in basal cell carcinoma: flat surface and multiple small erosions predict superficial basal cell carcinoma in lighter skin types. Br J Dermatol 2016;175(4):751-761.

76. Kittler H, Rosendahl C, Cameron A et al. Dermatoscopy : An algorithmic method based on pattern analysis. Vienna: Facultas.wuv Universitäts; 2016.

77. Argenziano G. Dermoscopy of melanocytic hyperplasias: subpatterns of lentigines (ink spot). Arch Dermatol 2004;140(6):776.

78. Blum A , Roehm S. Accessory nipple looks like dermatofibroma in dermoscopy. Arch Dermatol 2003;139(7):948-949.

79. De Giorgi V, Massi D, Stante M et al. False "melanocytic" parameters shown by pigmented seborrheic keratoses: a finding which is not uncommon in dermoscopy. Dermatol Surg 2002;28(8):776-779.

668 80. Longo C, Zalaudek I, Moscarella E et al. Clonal seborrheic keratosis: dermoscopic and
669 confocal microscopy characterization. J Eur Acad Dermatol Venereol 2014;28(10):1397-
670 1400.

ABBREVIATIONS AND ACRONYMS:

AK – Actinic Keratosis

BCC – Basal Cell Carcinoma

CME - Continuing Medical Education

DEJ – Dermal-Epidermal Junction

IDS - International Dermoscopy Society

LM – Lentigo Maligna

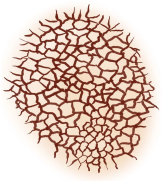
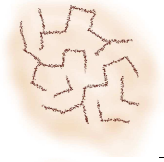
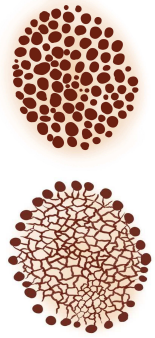
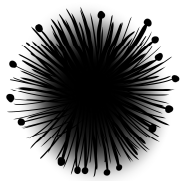
LPLK - Lichen Planus-Like Keratosis

SCC – Squamous Cell Carcinoma

SK – Seborrheic Keratosis

TABLES:

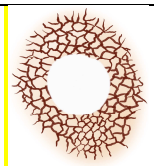
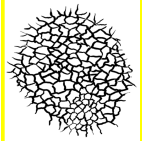
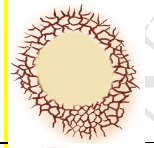
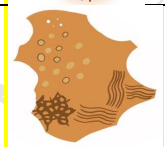
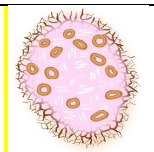
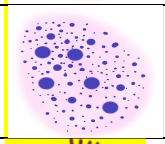
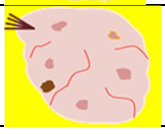
Table I. Dermoscopic structures relatively specific for melanocytic neoplasms

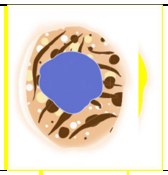
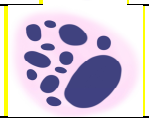
Schematic illustration	Metaphoric term	Descriptive term	Histopathological correlate	Clinical association
	Pigment network	Lines, reticular	Lines are due to pigmented keratinocytes and/or melanocytes along the dermo-epidermal junction. Spaces between the lines (holes) correspond to the suprapapillary plate	Regular: melanocytic nevus Irregular: dysplastic nevus, melanoma
	Negative pigment network	Lines, reticular, hypopigmented, around brown clods	Remains to be elucidated but preliminary work suggests that it corresponds to hypopigmented elongated rete ridges bridging and surrounding large nests of melanocytes within the dermal papillae	Spitz nevus, melanoma
	Angulated lines	Lines, angulated or polygonal	Confluent atypical melanocytes along an attenuated DEJ and melanophages in the papillary dermis	Lentigo maligna, melanoma on sun-exposed skin
	Globules	Clods, round or oval, aggregated or circumferential (rim of globules)	Nests of nevomelanocytes at the dermo-epidermal junction or dermis	Regular: melanocytic nevus Irregular: dysplastic nevus, melanoma
	Streaks (always at the periphery): radial streaming, pseudopods	Radial streaming: Lines, radial and segmental Pseudopods: Lines, radial and segmental with knobs at their tips	Confluent junctional nests of melanocytes at the periphery	Regular: Reed nevus Irregular: melanoma
	Homogenous blue pattern	Structureless blue	Dermal population of densely pigmented melanocytes	Blue nevus, melanoma

683

684 **Re-printed with permission of Ralph Braun and Ashfaq Marghoob (partial content in**
685 **Dermoscopedia.org).**
686

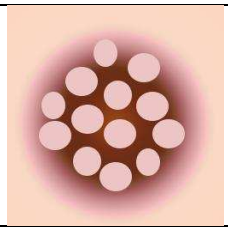
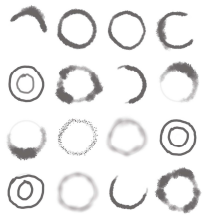
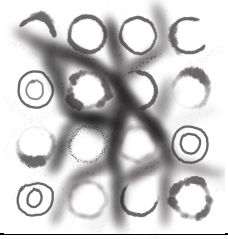
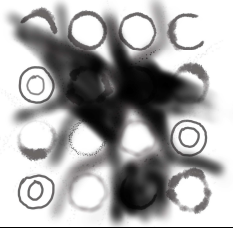
687 **Table II.** Dermoscopic features with high specificity for melanocytic neoplasms that can rarely
688 also be seen in non-melanocytic lesions, and its histopathologic correlate
689 Abbreviations: Seborrheic keratosis (SK)

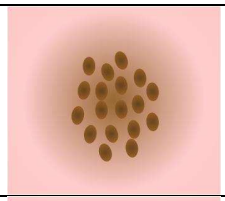
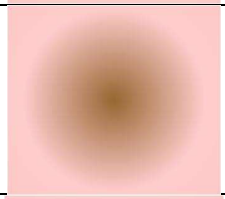
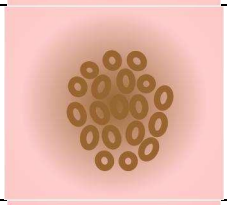
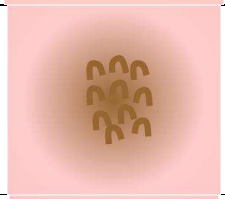
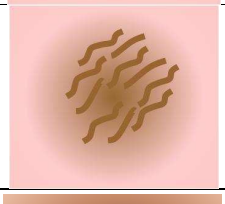
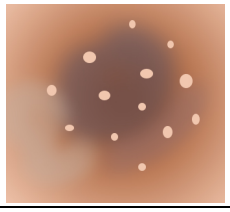
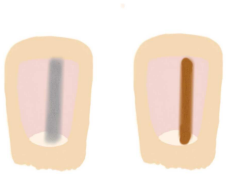
Dermoscopic feature	**Cutaneous neoplasm**		**Histopathologic correlate**
Pigment network	Dermatofibroma[19]		Hyperpigmentation of basal keratinocytes
	Ink spot lentigo[77]		Hyperpigmentation of basal keratinocytes
	Accessory nipple[78]		Areolar epidermal hyperplasia
	Seborrheic keratosis / solar lentigo [20, 79]		Coalescence of rete ridges with pigmented basaloid cells
Pigmented globules	Clonal seborrheic keratosis[80]		Compact nests of pigmented keratinocytes (Borst-Jadassohn phenomenon)
	Dermatofibroma[19]		Flattened, confluent, hyperpigmented rete ridges
	Basal cell carcinoma[20, 69]		Small pigmented tumor islands
Streaks	Seborrheic keratosis[20]		Coalescence of rete ridges with pigmented basaloid cells
	Basal cell carcinoma[20, 69]		Tumor cords at the periphery of the lesion

Homogenous blue	Seborrheic keratosis[20, 80]		Compact areas of pigmented keratinocytes
	Radiation tattoo[20]		Ink deposited in the dermis
	Basal cell carcinoma[20, 69]		Dermal pigmented tumor nests with melanocytes and melanophages

690
691 **Re-printed with permission of Ralph Braun and Ashfaq Marghoob (partial content in**
692 **Dermoscopedia.org).**
693

694 **Table III**. Dermoscopic structures present in melanocytic neoplasms located in special sites

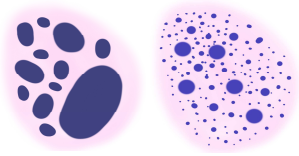
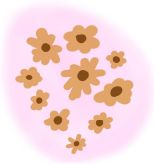
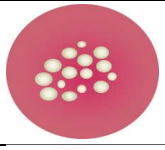
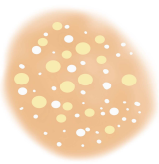
	Schematic illustration	Metaphoric term	Descriptive term	Histopathological correlate	Clinical association
Volar skin		Parallel Furrow Pattern	Lines, parallel, thin, in the furrows	Pigmented keratinocytes and melanocytes in the furrows (crista limitants)	Acral nevus
		Parallel Ridge Pattern	Lines, parallel, thick, on the ridges	Melanocytes in the rete ridges associated with the acrosyringia (crista intermedia)	Acral melanoma
Face		Pseudonetwork	Structureless, brown, interrupted by follicular openings	Pigmented cells in the epidermis and the dermal-epidermal junction interrupted by follicular openings	Facial nevus
		Concentric circles (circles within circles)	Circles, concentric. The pigmented ring can be seen within and surrounding the adnexal opening	Junctional proliferation of atypical melanocytes along the dermal-epidermal junction with varying degrees of follicular and dermal invasion	Lentigo maligna
		Grey circles	Circles, gray. Small gray rings within follicular openings		
		Asymmetric pigmented follicular openings	Circles, incomplete. Pigment rings that do not uniformly surround an adnexal opening		
		Rhomboids/zig-zag pattern	Lines, angulated or polygonal, surrounding adnexal openings		
		Blotches with obliteration of follicles	Structureless zone, brown black, with loss of visible adnexal openings		

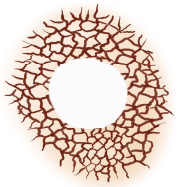
Mucosa		Dotted/globular patterns	Dots or clods, round or oval, brown	Aggregates of melanin in the upper lamina propria	Mucosal nevus, mucosal melanosis
		Homogenous pattern	Structureless area, brown	Flattened rete ridges and acanthosis	
		Ring-like pattern	Circles, or half-circles, brown	Hyperpigmented epithelial cells and broadened rete ridges which skip the papillae	
		Fish scale-like pattern (variant of ring-like pattern)			
		Parallel, reticular-like or hyphal pattern	Lines, slightly angulated, brown	Hyperpigmentation of the tip of the rete ridges which are distributed obliquely	
		Homogenous pattern with the presence of blue, gray, or white colors	Structureless areas with blue, gray, or white color	Suspicious for mucosal melanoma	Mucosal melanoma
Nails		Regular pigmented bands	Parallel lines originating from the proximal nail fold, without variation in colors, thickness or spacing	Most likely reveals a benign condition in the nail matrix	Brown: nevus Gray: lentigo
		Irregular pigmented bands	Lines origination from the proximal nail fold showing multiple colors (black, brown, gray), variation in the thickness and spacing of lines, and loss of parallelism	Most likely reveals a melanoma in the nail matrix	Nail matrix melanoma

695

Re-printed with permission of Zachary Wolner, Oriol Yélamos, Ralph Braun, and Ashfaq Marghoob (partial content in Dermoscopedia.org).

699 **Table IV.** Dermoscopic structures with high specificity for non-melanocytic neoplasms.
700 Abbreviations: BCC, basal cell carcinoma; DEJ, dermal-epidermal junction; SCC, squamous cell
701 carcinoma; DF, dermatofibroma

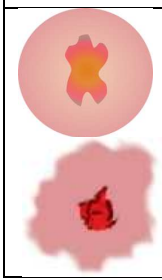
Clinical association	**Schematic illustration**	Dermoscopic structures	**Definition**	**Histopathological correlation**
Basal cell carcinoma		Blue-gray ovoid nests, multiple blue-gray globules and dots	**Clods, dots, blue/gray, not aggregated**	**Large (ovoid nests) or small (globules) basal cell carcinoma nodules in the dermis. Dots are small BCC nests at DEJ or in superficial dermis.**
		Leaflike areas	**Lines, radial, connected to a common base**	**Pigmented basal cell carcinoma nests connected to each other at the dermal-epidermal junction**
		Spoke wheel areas, concentric structures	**Spoke wheel areas: lines, radial, converging to a central dot or clod Concentric structures: clod within a clod**	**Pigmented basal cell carcinoma nests and cords connecting to each other at the dermal-epidermal junction**
Actinic keratosis		Strawberry pattern	**Structureless, red, interrupted by follicular openings**	**Localized increase of vasculature and follicular hyperkeratosis**
SCC		White circles	**Bright white circles surrounding a dilated infundibulum**	**Acanthosis and hypergranulosis of the infundibular epidermis**
Bowen disease		Linear dark dots / globules	**Dots, clods, peripheral, arranged in lines**	**Atypical clusters of basal pigmented keratinocytes**
Seborrheic keratosis		Milia-like cysts	**Dots or clods, white, clustered or disseminated**	**Intraepidermal keratin cysts**

		Comedo-like openings/crypts	**Clods, brown, yellow, or orange, rarely black**	**Epidermal invaginations filled with keratin**
DF		Central white patch	**Structureless zone, white, central**	**Prominent fibrosis in the papillary dermis**

Re-printed with permission of Zachary Wolner, Oriol Yélamos, Ralph Braun, and Ashfaq Marghoob (partial content in Dermoscopedia.org).

Table V. Non-specific dermoscopic structures

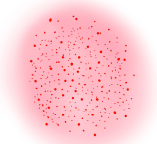
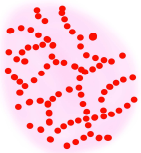
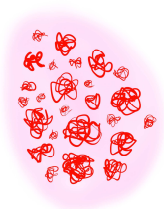
Schematic illustration	Metaphoric term	Descriptive term	Histopathological correlate	Clinical association
	Blotch	Structureless zone, brown or black	Aggregates of melanin in the stratum corneum or throughout all layers of the skin	Nevus, melanoma, seborrheic keratosis, basal cell carcinoma
	Dots	Dots, black or brown	Aggregates of melanocytes or melanin granules. If black, in upper epidermis; if brown, in lower epidermis	Nevus, basal cell carcinoma, melanoma, keratinocyte carcinomas
	Peppering / granularity and scarlike depigmentation	Peppering/granularity: dots, gray Scarlike depigmentation: structureless zone, white. Often seen together	Peppering/granularity: regression with melanophages. Scarlike depigmentation: fibrotic papillary dermis	Melanoma, lichen planus-like keratosis, melanocytic nevus (if focal)
	Shiny white structures (only seen with polarized dermoscopy)	Shiny white streaks: lines, white, perpendicular	Unclear. Suspected increased collagen and dermal fibroplasia	Spitz nevus, dysplastic nevus, melanoma, lichen planus-like keratosis, basal cell carcinoma
		Rosettes: dots, white, four arranged in a square	Hyperkeratosis in the follicular openings alternating with the normal surrounding stratum corneum	Actinic keratosis, squamous cell carcinoma, melanoma
		Shiny white blotches and strands: clods, white, shiny	Unclear: Suspected to be fibrosis in the underlying stroma	Basal cell carcinoma, melanoma, lichen planus-like keratosis

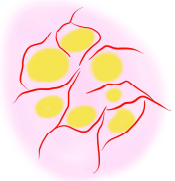
	Blue-whitish veil	Structureless zone, blue with a white ‘ground glass’ haze found over a raised area that does not occupy the entire lesion.	Heavily pigmented dermal melanocytes combined with compact orthokeratosis	Melanoma, Spitz / Reed nevus, seborrheic keratosis, pyogenic granuloma, basal cell carcinoma
	Scale	Homogenous opaque yellow to brown structures	Hyperkeratosis and parakeratosis	Actinic keratosis, squamous cell carcinoma, porokeratosis, and inflammatory skin diseases
	Erosion / Ulceration	Structureless dark red to brown areas with a serous crust.	Erosion: loss of the epidermis. Ulceration: loss of the epidermis and superficial dermis	Basal cell carcinoma, squamous cell carcinoma, traumatism, melanoma

707

Re-printed with permission of Zachary Wolner, Oriol Yélamos, Ralph Braun, and Ashfaq Marghoob (partial content in Dermoscopedia.org).

Table VI. Vessels identified on dermoscopy and typical clinical associations[4, 6]

Schematic illustration	Metaphoric term	Descriptive term	Clinical association
	Arborizing vessels	Branched vessels, large	Basal cell carcinoma (nodular)
	Lacunae	Clods, red, purple, black	Angioma (red, purple lacunae, angiokeratoma (blue, black lacunae)
	Serpentine vessels	Linear irregular vessels	Basal cell carcinoma (superficial), melanoma, scars
	Dotted vessels	Red dots	Spitz nevus, melanoma, inflammatory conditions, stasis dermatitis
	String of pearls	Serpiginous vessel arrangement of dotted vessels	Clear cell acanthoma
	Comma vessels	Curved, short vessels	Intradermal nevus (if monomorphous), melanoma (if polymorphous)
	Hairpin vessels	Looped vessels	Seborrheic keratosis, keratinizing tumors / keratoacanthoma, warts
	Glomerular vessels	Coiled vessels	Squamous cell carcinoma / Bowen disease

	Crown vessels	Vessels arranged radially, do not cross the center of the lesion	Sebaceous hyperplasia
	Polymorphous vasculature	Multiple vessel morphologies	Melanoma, Merkel cell carcinoma, angiosarcoma, eccrine poromas, squamous cell carcinoma

Re-printed with permission of Ralph Braun and Ashfaq Marghoob (partial content in Dermoscopedia.org).

-FIGURE LEGENDS:

Fig 1. Melanoma arising in a nevus. **A**, Color dermoscopy showing a pigmented lesion with pigment network and central negative network (arrowhead). **B**, Black and white dermoscopy enhances the identification of the negative network (arrowhead). **C**, Histologically, the negative network area revealed the presence of a melanoma arising in a nevus.

Fig 2. Junctional nevus. The presence of pigment network on dermoscopy (A) corresponds histologically to the presence of nevomelanocytes and pigmented keratinocytes along the dermal-epidermal junction (B).

Fig 3. On dermoscopy, globules (A) can reveal nests of nevomelanocytes located in the dermal epidermal junction or in the dermis (B).

Fig 4. Reed nevus. **A**, dermoscopically the lesion presented with a regular starburst pattern presenting with pseudopods (arrowhead). **B,** Histologically, pseudopods corresponds to confluent nests of melanocytes at the periphery.

Fig 5. Melanocytic lesions located in volar skin. **A,** Dermoscopic image showing a parallel furrow pattern. **B,** The presence of a pigment in the furrows (rectangle) corresponds histologically to the presence of melanocytes in the crista limitants (arrow) and is generally indicative of a nevus. **C**, Dermoscopic image showing a parallel ridge pattern. **D**, The presence of pigment in the ridges corresponds histologically to the presence of melanocytes in the crista intermedia (arrowhead) and should raise suspicion for melanoma.

742 **Fig 6.** Lentigo maligna. **A,** On dermoscopy, this lesion presents with concentric circles
743 (arrowheads), asymmetric pigmented follicular openings (arrows) and angulated lines (asterisk).
744 **B,** Histologically, the presence of these findings correlates with proliferation of atypical
745 melanocytes along the dermal-epidermal junction with follicular involvement.
746
747 **Fig 7**. Subungual melanoma. **A**, Dermoscopic image showing a pigmented band revealing
748 irregular lines along the nail plate. **B**, Free-edge dermoscopy showing pigment predominantly in
749 the lower portion of the nail plate, suggesting that the melanocytic lesion is located in the distal
750 nail matrix. **C and D**, Histologic results of the nail matrix confirmed the presence of a
751 melanoma.
752
753 **Fig 8**. Basal cell carcinomas showing dermoscopic features with high specificity for basal cell
754 carcinoma. **A**, Dermoscopic image revealing a large ovoid nest (arrowhead). **B**, Histologically,
755 this corresponded to a large BCC dermal tumor nest. **C**, Dermoscopic image showing a leaflike
756 structure (arrow). **D**, Histologically, this corresponded to a BCC tumor cord connected to the
757 epidermis and is diagnostic of superficial basal cell carcinoma.
758
759 **Fig 9**. Seborrheic keratosis. **A**, Dermoscopic image revealing comedo-like openings (arrow) and
760 milia-like cysts (arrowhead). **B**, The former corresponds to epidermal invaginations filled with
761 keratin (arrow), whereas the latter corresponds to intraepidermal keratin cysts (arrowhead).
762
763 **Fig 10.** Examples of dots on dermoscopy and its histopathological correlates**. A,** In this
764 melanocytic nevus, black dots on the network correspond to small nests located in the upper
765 epidermis (B). **C,** In this melanoma, blue-gray dots, also kwown as peppering or granularity,

766 correspond to melanophages (arrowhead, D) and can be associated with scarlike depigmentation
767 (asterisk) which corresponds to dermal fibrosis (asterisk, D).
768
769 **Fig 11** Invasive melanoma. **A,** Dermoscopic image showing a blue-whitish veil and shiny white
770 streaks. **B,** Blue-whitish veil is associated with a proliferation of pigmented dermal melanocytes
771 together with compact orthokeratosis, whereas shiny white streaks is associated with dermal
772 fibrosis.